

WHAT IS CLAIMED IS:

- 1     1.   Apparatus for printing images on a printing medium,  
2     by construction from individual marks; said apparatus  
3     comprising:  
4         a platen locating such medium;  
5         at least one printhead marking on such medium;  
6         a carriage holding the head;  
7         a rod supporting the carriage for scanning motion  
8     across such medium;  
9         a sensor, at least partially mounted to the carriage,  
10    measuring relative distances between the sensor and the  
11    platen or such medium; said sensor comprising first proc-  
12    essor portions interpreting intensity of reflected radia-  
13    tion, at each of plural positions along the scanning mo-  
14    tion respectively, as a measure of respective transmission  
15    distances from the source to the sensor via reflection  
16    from the platen or such medium; and  
17         second microprocessor portions modifying the marking  
18    by the head to compensate for variation of the measured  
19    distances during the scanning motion.
- 1     2.   The apparatus of claim 1, wherein the sensor further  
2     comprises:  
3         a radiation source emitting radiation toward the  
4     platen or such medium;  
5         a detector receiving source radiation reflected from  
6     the platen or such medium.

1     3.    The apparatus of claim 1, wherein:  
2           the radiation source emits substantially incoherent  
3    radiation; and  
4           the sensor is a single-channel device.

1     4.    The apparatus of claim 1, wherein:  
2           the sensor comprises means for measuring the relative  
3    distances without printing on such medium.

1     5.    The apparatus of claim 1, wherein:  
2           the sensor comprises means for measuring the relative  
3    distances at multiple positions substantially along the  
4    length of the rod.

1     6.    The apparatus of claim 1, wherein the modifying means  
2    comprise:  
3           memory storing the respective transmission-distance  
4    measures for the plural positions; and  
5           third microprocessor portions for retrieving the  
6    transmission-distance measures for the plural positions,  
7    to use in compensation, by the second portions, for corre-  
8    sponding positions along the rod respectively.

1 7. The apparatus of claim 1, wherein the second micro-  
2 processor portions are selected from the group consisting  
3 of:  
4 microprocessor portions for modifying signals from an  
5 encoder that reports position or speed, or both, of the  
6 carriage along the rod, to compensate for the distance  
7 variations;  
8 microprocessor portions for controlling position or  
9 speed, or both, of the carriage along the rod to compen-  
10 sate for the distance variations;  
11 microprocessor portions for controlling timing of ac-  
12 tuation of said marking by the head, to compensate for the  
13 distance variations;  
14 microprocessor portions for controlling velocity of  
15 propagation of said marking from the printhead toward such  
16 medium, to compensate for the distance variations;  
17 microprocessor portions for adjusting position speci-  
18 fications in image data to compensate for the distance  
19 variations;  
20 microprocessor portions for adjusting positional re-  
21 lationships between color planes in image data, to compen-  
22 sate for the distance variations; and  
23 microprocessor portions for modifying pixel structure  
24 of image data, to compensate for the distance variations.

1 8. A method of compensating operation of a printer,  
2 which printer has printheads carried on a scanning car-  
3 riage next to a printing-medium position; said method com-  
4 prising the steps of:

5 scanning a surface substantially at the printing-  
6 medium position using a single-channel optical sensor  
7 operating with substantially incoherent light;

8 applying a signal from the sensor to compute a print-  
9 head-to-printing-medium spacing (PPS) profile along said  
10 scanning, using a known correlation function;

11 adjusting marking positions of the printheads, based  
12 on the computed PPS profile.

1 9. The method of claim 8:

2 further comprising the step of loading unprinted,  
3 bare printing medium into the printer; and

4 wherein the surface-scanning step comprises scanning  
5 the unprinted, bare medium.

1 10. A method of calibrating a printer, which printer has  
2 printheads carried on a scanning carriage next to a print-  
3 ing-medium position, and has a carriage support-and-guide  
4 rod subject to imperfection in geometrical relation with  
5 the printing-medium position; said method comprising the  
6 steps of:

7 projecting radiation from the carriage toward the  
8 printing-medium position for reflection back toward the  
9 carriage, at plural locations of the carriage along the  
10 rod;

11 measuring intensity variations of reflected radiation  
12 received on the carriage at the plural locations;

13 interpreting the intensity variations as directly due  
14 to attenuation in travel of the radiation through the dis-  
15 tance from the carriage toward the printing-medium posi-  
16 tion and back to the carriage; and

17 retaining the interpreted intensity-variation infor-  
18 mation for use in compensating the imperfection.

1 11. The method of claim 10, wherein:

2 the projecting step comprises projecting the radia-  
3 tion to a printing medium disposed at the printing-medium  
4 position;

5 the measuring step comprises receiving the radiation  
6 reflected from the printing medium; and

7 the attenuation is due to scattering of the radiation  
8 in the reflection, and divergence of the radiation during  
9 said travel.

1 12. The method of claim 11, wherein, during said project-  
2 ing and receiving :  
3 substantially nothing has been printed on the print-  
4 ing medium;  
5 whereby the printing medium is substantially bare  
6 printing medium.

1 13. The method of claim 10, wherein:  
2 the projecting step comprises projecting the radia-  
3 tion to a platen disposed substantially at the printing-  
4 medium position; and  
5 the measuring step comprises receiving the radiation  
6 reflected from the platen.

1 14. The method of claim 13, wherein:  
2 the interpreting step comprises making a distance  
3 allowance for thickness of printing medium absent from the  
4 platen.

1 15. The method of claim 10, wherein:  
2 the interpreting step comprises referring to a previ-  
3 ously determined correlation function between intensity  
4 variation information and printhead-to-printing-medium  
5 spacing.

1 16. A method of determining printhead-to-printing-medium  
2 spacing (PPS) in an incremental printer, using a plural-  
3 lamp sensor; said method comprising the steps of:  
4 defining a design value for PPS in the printer;  
5 calibrating the sensor, with each lamp of the plural-  
6 ity respectively, at the design PPS value;  
7 installing the calibrated sensor in the printer;  
8 operating the sensor, with each lamp of the plurality  
9 respectively, in such a way as to develop a sensor output  
10 signal representing at least one difference between PPS  
11 measurements with a corresponding pair of the lamps; and  
12 interpreting the at least one difference signal as a  
13 PPS displacement from the design PPS value, to determine  
14 actual PPS in the printer.

1 17. The method of claim 16, wherein the operating step  
2 comprises:  
3 using the sensor with the pair of lamps in alterna-  
4 tion to develop an a. c. signal output representing said  
5 at least one difference.

1 18. The method of claim 17, wherein:  
2 the operating step further comprises using the sensor  
3 with another pair of lamps in alternation to develop an-  
4 other a. c. signal output representing another difference;  
5 and  
6 the interpreting step comprises computing a mean of  
7 the differences.

1 19. The method of claim 18, wherein:  
2 the computing comprises weighting the differences in  
3 an inverse relation to signal noise associated with each  
4 difference.

1 20. The method of claim 19, wherein:  
2 the computing comprises finding said mean as a root-  
3 mean-square of the weighted differences.

1 21. Apparatus for printing an image on a printing medium,  
2 by construction from individual marks; said apparatus  
3 comprising:  
4 a platen locating such medium;  
5 an array of printing elements marking on such medium,  
6 said array being of length at least as great as width of  
7 such image;  
8 an advance mechanism providing relative motion of  
9 such medium and the array, substantially at right angles  
10 to the array length;  
11 a carriage scanning lengthwise along the array;  
12 a sensor, at least partially mounted to the carriage,  
13 measuring relative distances between the sensor and the  
14 platen or such medium; said sensor comprising first proc-  
15 essor portions interpreting intensity of reflected radia-  
16 tion, at each of plural positions along the scanning mo-  
17 tion respectively, as a measure of respective transmission  
18 distances from the source to the sensor via reflection  
19 from the platen or such medium; and  
20 second microprocessor portions modifying the marking  
21 by the array to compensate for variation of the measured  
22 distances along the array length.

- 1 22. The apparatus of claim 21, wherein:  
2 the carriage carries exclusively the sensor or por-  
3 tions thereof, not the array.

094270.08280  
108280.0202460